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Keynote Address
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Thank you, Mark, for that warm introduction. And thank you, Bob Rassa and NDIA for both sponsoring this event and inviting me to speak. I am especially pleased to see so many industry associations participating in providing a forum for a very important topic. Our industry partners are critical to the successful achievement of DoD's objectives.

This first annual NDIA Systems Engineering and Supportability Conference represents a major step since we now have both DoD and industry engineers talking about the supportability concerns that logisticians have had for many years. And I have to say that calling this the first ANNUAL conference indicates a commitment to dealing with these issues for the long haul—and it will take that kind of long term commitment.

We are seeking to improve DoD weapons systems supportability by way of effective systems engineering—not only on new acquisitions, but also on legacy systems. And because of the very direct relationship of supportability to the total cost of ownership, robust system engineering produce not only better quality weapons, but also more affordable weapons. Those of you attending this conference must recognize both the importance of supportability and the value of systems engineering to achieving it.

Background

Since the end of the Cold War we have made some very deep cuts in our national security apparatus and adjusted our force structure to meet the demands of a new and very different security environment that we see today.

At the same time that we drew down, as you all know, we also became much busier. The end of the Cold War left us with a more complex, a more

unpredictable, a more volatile world than we ever could have foreseen in the early 1990s.

In Iraq and Somalia, in Haiti and Rwanda, and of course today in Bosnia andKosovo, we have seen the face of future conflicts. Conflicts that reflect a lot of the bitter divisions of the past. In the Far East and Southwest Asia we continue to face rogue states that have some very large military capabilities, as well as some capabilities that come with chemical, biological, and nuclear weapons and the means to deliver them.

Today as we meet here, in support of our military strategy, we have about 120,000 servicemen and women deployed away from home for training or what we call named operations around the world. The level of activity that we have maintained since the end of the Cold War, as you well know, has been very challenging.

The dilemma we face right now involves competing—and seemingly unlimited--demands for constrained resources. We simply cannot afford all that we would like to do—or even all that we must do. With fixed total resources, we have resorted to "robbing Peter to pay Paul," taking from future investments in modernization to maintain current readiness. Yet we all know that we must develop the new systems needed to meet the challenges of early 21st century. And we must modernize our current equipment in order to maintain our military superiority in the face of potential adversaries, equipped off the world's commercial or military markets, and their increasing use of asymmetrical warfare.

We must simultaneously shift our focus from the traditional weapons platforms (ships, planes, and tanks) to weapons that will counter these future asymmetrical threats—such as defenses against biological warfare, information warfare, and ballistic missiles. And, on the offensive, we must increase our funding on enhanced and secure C3I and precision weapons.

We must also face the reality that, for the foreseeable future, the vast majority of the systems we will use are those that are already deployed. Because we stopped modernizing over the last decade—when our procurement account dropped by more than 70 percent—we are now spending billions, for example, to maintain an aging fleet of aircraft—75 percent of which will soon have an average age of more than 20 years. Flying

hour costs for that aging fleet have risen almost 70 percent during the past four years, and maintenance costs are skyrocketing. Worse still, the age and deteriorating state of these systems is having an effect on readiness. They demand more and more dollars to just keep them going.

Dr Gansler has characterized this as being "trapped in a death spiral." The requirement to maintain our aging equipment is costing us much more each year: in repair costs, down time, and maintenance tempo. But we must keep this equipment in repair to maintain readiness. It drains our resources—resources we should be applying to modernization of our traditional systems and development and deployment of the new systems. S, we stretch out our replacement schedules to ridiculous lengths and reduce the quantities of new equipment we purchase—raising their costs and still further delaying modernization.

Compounding the problem is the increased operational tempo required by our worldwide role as the sole remaining superpower, which more rapidly wears out the old equipment.

To break out of this cycle will be extremely difficult. It will require significant cultural change, a sense of urgency, and implementation of difficult decisions. It will not be enough simply to accept the notion of the need for a Revolution in Military Affairs and the need for a Revolution in Business Affairs. **Action now** is essential for our security in the 21st century.

Criticality of the Supportability Issues

Let me give some idea of the magnitude of the supportability issue—put it in context for you.

As an organization, one of our real challenges is to manage about 70 years of technology at any one point in time. We operate, on a daily basis, aircraft that were designed back in the early 50s and we still have to maintain them, buy spare parts for them, and keep them updated. At the same time, we are working on research and development programs for systems that won't be fielded until 2015-2020. Managing that spectrum of technology is a real challenge.

Fully one-third of the DoD budget (about $80 billion per year) and nearly half of the Department's manpower (1,250,000 military and civilians) is in Logistics. To get some perspective on that, in the active military we have 290,000 personnel in the combat forces and twice that number of active military in the logistics force.

If we examine what happened from 1988 to 1998, procurement dollars fell by more than 70 percent. Operations and maintenance on the other hand, reduced only 16 percent. On a per troop basis, operations and support costs actually grew from $107K to $125K per troop.

In *The Art of War*, Sun Tzu estimated that 60 percent of military spending is required to cover broken down chariots, worn out horses, armor, arrows and crossbows, supply wagons and other support costs. Things haven't changed much. While the weapons are different, the high cost of maintaining them isn't. The Navy, for instance, estimates 64 percent of the lifetime costs of a surface combatant ship can be attributed to operation and support.

This picture is not improving. Consider in the 1970s, operations and support costs typically accounted for up to 60 percent of a systems total life-cycle costs. For many reasons, not the least of which being that weapon systems as general rule are remaining in the DoD inventory much longer than originally planned, the O&S costs as a percentage of total life cycle costs have been steadily increasing to the point where they are now estimated to be closer to 72 percent.

Relationship between Acquisition and Logistics

This adds up to a very real and very substantial shared challenge for the acquisition and logistics communities.

Now consider that for all our systems, both new and legacy, a significant portion of O&S costs is directly attributed to the design decisions made during the early phases of the acquisition process. The major categories of cost drivers include fuel and other expendables, spares—both initial and replenishment, operating personnel, and both maintenance and repair labor—with people being the largest element. But all factors that are influenced very early in the acquisition process. And this is one of the places

where the acquisition and logistics community must come together to face the challenges.

Success will occur when our different, but complementary, approaches and perspectives are brought together. The final value added is then greater than the sum of the parts. Without a doubt, the most essential tenet of Integrated Product and Process Development (IPPD) is multidisciplinary teamwork.

On the acquisition side, our multifunctional IPTs now include Logisticians as key players on the product development team - providing the logistics community with the opportunity to make sure that supportability considerations **are** an integral part of the design and development processes from the very start. A major challenge for the Logistician is the ability to bring supportability and logistics issues of substance "to the table" in a way that all IPT participants can understand, appreciate and successfully resolve.

Having aggressively brought the Acquisition Logistician into the development process earlier we can address sustainment issues during system design where ninety percent of the cost of owning a weapons system is determined. Where they can have an impact on increasing fuel efficiency, reducing the consumption rates of expendables like ammunition, more reliable and durable spares, design for ease of repair, reduced size and weight, and very importantly system designs that decrease the number of operations and support personnel.

Let's consider aircraft as an example. The next generation of military aircraft, may be faster, fly farther, use less fuel, and be much lighter. The next generation of military aircraft will also require more power for more sensors and weapons systems. The number of electric motors on board an aircraft has risen dramatically over the past 20 years as fly-by-wire systems have been introduced. At the same time, systems are becoming increasingly reliable. In general, there is a move away from numerous, separately specified system components to integrated networks.

Traditionally, aircraft electrical systems have been designed on a centralized basis, with generators supplying power to a power center that then distributes it to the aircraft's systems. In a distributed, or integrated, architecture, the long runs of individual power wires are replaced with

secondary power feeders linked to multiplexed data bus lines. The integrated network eliminates components and wires; reduces weight, installation, and testing times; and increases reliability.

According to some manufacturers' figures, with use of distributed power systems, the number electrical components can be cut by 35 percent, wire segments by 40 percent, weight by 40 percent, and installed time by 60 percent. In addition, reliability can be improved by 20 percent. A win-win-win situation for acquisition, logistics, and warfighter.

NAVAIR, for legacy systems, has been able to break down major cost categories to 136 discrete cost elements and identify internal and external factors that influence them. This has helped managers target areas for cutting costs.

But only through detailed analysis of weapons systems and by documenting how weapons wear, the cost of repairing individual parts, etc., will we be able to manage total ownership costs. You have to break down very complex systems to determine where a small investment can have a high payoff.

So far, NAVAIR has identified savings of $404 million over a five-ear period by adopting logistics reengineering proposals to make design improvements on items with high cost and high failure rates.

The challenge will be to make those initial investments that could reap long-term savings. This is very difficult when you are living hand-to-mouth. Higher costs today are hard to sell for promised savings tomorrow.

This is why we must treat life cycle costs as an independent variable-something that is consciously considered up front in the design process and giving it an "equal place at the table" along with system performance. Something that gets the focused attention of the Joint Requirements Oversight Council (JROC). Something that we hold program managers accountable for.

The Defense Science Board has estimated that the return on investment for designing in supportability can be 3-5:1. And we can cite the LPD-17 example where an investment of approximately $28 million per ship can

result in a 20 percent reduction in total ownership costs or about $4 billion over fleet lifetime.

The Open Systems Approach

One of the ways we can design with life cycle considerations in mind is the open systems approach which is both a technical approach and a preferred business strategy.

With an open systems approach, program managers can have access to alternative sources for the key subsystems and components to construct DoD systems. DoD investment early in the life-cycle is reduced since at least some of the required subsystems or components are likely to already be available, or being developed without direct DoD dollars. Production sources can be competitively selected from multiple competitors.

The system design flexibility inherent in the open system approach, and the more widespread availability of conforming commercial products, mitigates potential problems associated with a diminishing defense-dependent manufacturing base. Finally, life-cycle costs are reduced by a long-lived, standards based architecture that facilitates upgrades by incremental technology insertion, rather than by large scale system redesign.

If we had used an open systems approach to designing the B-52, I wonder how much we could have saved as we constantly evolved that aircraft over half a century to take on missions unthought of when it was first conceived!

Legacy Systems

With the number of "new starts" sharply declining, the real "target of opportunity for DoD budget savings lies not with new systems, but with the large number legacy systems now in the DoD inventories. Basically we need to approach the issue of our legacy systems similar to the way we now develop and acquire our new systems, subjecting upgrades and modifications to the same kinds of cost, performance, and schedule trade-offs, again treating cost as an independent variable. The principles of IPPD which we now successfully employ in the development and acquisition of new systems need to be applied equally to mods and upgrades as well.

For these systems, we need a business and engineering revolution similar to the one we have been experiencing in the acquisition community. We need to attack the O&S cost issues on a number of fronts. Not only do we need to apply systems engineering principles to our weapons systems, we need to apply systems engineering principles to our logistics infrastructure. Again, an acquisition-logistics partnership.

There are great economies to be gained from re-engineering and modernizing the DoD logistics infrastructure. We already have major changes underway in this arena, and shortly we'll be hearing from Mr. Lou Kratz who is heading up our Logistics Reengineering and Modernization effort. I will leave it to Lou to tell you about all the things we are doing now and intend to do in the near future to reengineer and modernize DoD's logistics. These changes hold great promise in further helping to lower the cost of supporting not only the legacy systems but also our future systems.

Summary and Closing

As I close I would like to reemphasize my message to you:

- Modernization of our forces must take place—and it must take place within the existing budget constraints.

- We must lower logistics costs before the tail totally consumes the tooth.

- There are no simple solutions to lowering total ownership costs.

- O&S costs on our legacy systems represent a large target of opportunity that we must exploit.

- The same focus and commitment we applied to acquisition reform initiatives—IPPD, cost as an independent variable, open systems approaches--need to be carried over to the sustainment and in-service engineering arenas.

- We must break down the "walls or stovepipes" that separate the acquisition and logistics communities if we are to be successful

Listen closely to what Lou Kratz has to say about what the logistics community is doing hand-in-hand with the acquisitions community in terms of a business revolution to reduce the costs of the logistics infrastructure.

Together we will have discussed a number of strategies or initiatives that I believe will contribute to engaging our shared challenges. Undoubtedly these strategies and others will be discussed in more detail here this week.

Because of the unprecedented opportunities and challenges emerging from a rapidly changing world, I cannot emphasize too much our need to work together to succeed. We must rely on each other now more than ever before. If we join our talents and work together, we can and will meet those challenges.

Neither in DoD nor industry, none of us is as smart as all of us.